A New Species of *Lepidopleurus* Risso, 1826

(Mollusca : Polyplacophora)

in the Deep Waters of the Eastern Pacific

BY

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(1 Plate; 5 Text figures)

Upon completion of a review of the chiton family Lepidopleuridae Pilsbry, 1892, in the eastern Pacific (Ferreira, 1979), a few lots of lepidopleurids which had been left unexamined were brought to my attention. As fortune would have it, one of these lots proved to be of great scientific interest.

The material, generously loaned by Dr. William A. Newman, Scripps Institution of Oceanography, La Jolla, California, consists of 5 specimens preserved in alcohol, bearing the label: "MV 65-I-57/off Baja California Sur, SW of Cabo San Lucas/beam trawl, 1580-1370 fathoms [2891-2507 m]/22°30.8′N, 110°03.8′W tr. 22°37.2′N, 110°15.5′W/Carl L. Hubbs & party on *Horizon*, VII, 29-30, 1965." One of these specimens, about 3 cm in length, is clearly identifiable as *Leptochiton alveolus* (Lovén, 1846); the other 4 specimens are of a hitherto undescribed species of the genus *Lepidopleurus* Risso, 1826 (not Dall, 1879).

POLYPLACOPHORA de Blainville, 1816

Neoloricata Bergenhayn, 1955

Lepidopleuridae Pilsbry, 1892

Lepidopleurus Risso, 1826

Lepidopleurus scrippsianus Ferreira, spec. nov.

(Figures 1 to 6 and 7 to 11)

Diagnosis: Chitons of moderate size, white color. Valves rugose, strongly beaked. End valves and lateral areas of intermediate valves thick and prominent, smooth surface, with coarse concentric growth rugae. Central areas with irregularly distributed microgranules. Articulamentum white, with no slits. Sutural laminae small, triangular; sinus wide. Mucro posterior. Gills posterior. Girdle upper surface covered with large, juxtaposed spiculoid processes; under surface reduced to fine cuticle without scales. Radula with tricuspid major lateral teeth.

Description: Holotype – The specimen, rugose in appearance, subcarinate, preserved in alcohol, measures 12.1 mm in length, 8.2 mm in width. Tegmentum (Figure 5) uniformly white. Anterior valve with smooth surface except for coarse, concentric growth rugae. Intermediate valves strongly beaked. Lateral areas elevated and prominent; tegmental surface smooth except for coarse, irregular, concentric growth rugae. Central areas minutely granular, the granules irregularly placed and variably spaced. Posterior valve moderately inflated; mucro at the posterior 1/3 of the valve; postmucro with concentric growth lines, strongly convex, sloping sharply. Articulamentum (Figure 6) chalky white, without insertion teeth or slits; in the intermediate valves, posterior 1/3 of articulamental surface covered by the broadly reflected tegmentum. Sutural laminae small, triangular; sinus very wide. On valve viii: width of sinus/width of sutural laminae = 2.48 mm/1.68 mm = 1.48. Width of valve i/width of valve viii = 5.77 mm/5.67 mm = 1.02. Gills adanal, posterior, about 20 plumes per side, extending 40% of length of foot. Girdle creamy white, velvety in appearance, relatively thick and wide; maximum width (at level of valve iv), 2.2 mm. Girdle upper surface uniformly covered with juxtaposed spiculoid processes, 100 μm long,

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20 μm wide, with pointed tips, often broken and jagged (Figure 7); undersurface completely devoid of any scale-like formations, reduced to a thin cuticle. Radula, 5.8 mm long (48% of the specimen's length), comprises about 60

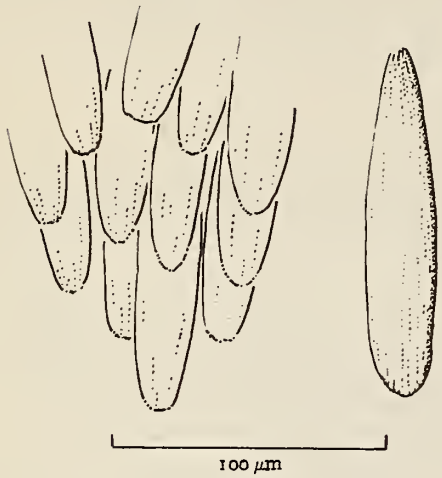

Figure 7

Lepidopleurus scrippsianus Ferreira, spec. nov. Holotype (CASIZ Type Collection no. 00716); spiculoid processes of the girdle's upper surface. Camera lucida drawing by Barbara Weitbrecht measured bar = 100μm

rows of mature teeth. Median tooth about 70 μm long and 30 μm wide in the front where it bears a small blade, enlarges posteriorly to a width of 48 μm; first lateral tooth, about 65 μm long, 45 μm wide, bears large tuberosity at the inner anterior corner bordering a socket-like formation (Figure 8). Major lateral tooth with a tricuspid head, about 80 μm wide and 100 μm long at the longest cusp (Figure 9). Spatulate tooth ("Seitenplatte") with strongly

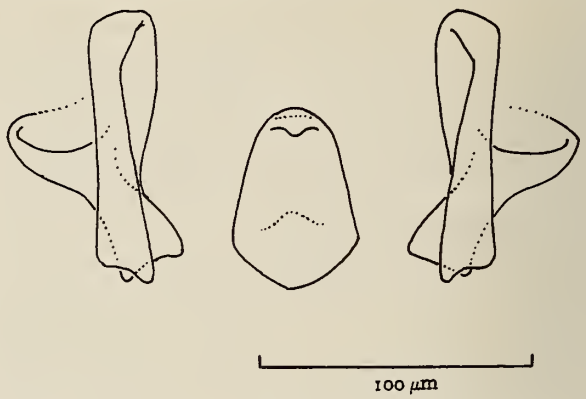

Figure 8

Lepidopleurus scrippsianus Ferreira, spec. nov. Holotype (CASIZ Type Collection no. 00716); median and first lateral teeth of radula. Camera lucida drawing by Barbara Weitbrecht measured bar = 100μm

fasciculated texture and a rake-like appearance (Figure 10). Outer marginal teeth about 80 μm long, 105 μm wide (Figure 11).

The specimen, disarticulated, with girdle and radula mounted on separate slides, is in the repository of the California Academy of Sciences, Department of Invertebrate Zoology, CASIZ Type Series No. 00716, CASIZ Type Slides Nos. 533, 534, and 535.

Paratypes: Three specimens from the same lot, slightly curled, preserved in alcohol, with the same color and general characteristics of the holotype; lengths and widths (including girdle), 20 x 10 mm, 15 x 8 mm, and 13 x 7 mm. Paratypes deposited, respectively, at the Scripps Institution of Oceanography, California Academy of Sciences (CASIZ Type Series 00717), and Natural History Mu-

Explanation of Figures 1 to 6

Lepidopleurus scrippsianus Ferreira, spec. nov.

Figure 1: Paratype, 15 mm long (CASIZ Type Collection no. 00717); dorsal view

Figure 2: Same as in Figure 1; side view

Figure 3: Same as in Figure 1; close-up of left side slope

Figure 4: Same as in Figure 1; close-up of central and lateral areas

Figure 5: Holotype (CASIZ Type Collection no. 00716); close-up of dorsal surface of anterior, intermediate, and posterior valves

Figure 6: Same as in Figure 5; close-up of articulamental surface of anterior, intermediate, and posterior valves

Figure 1

Figure 2

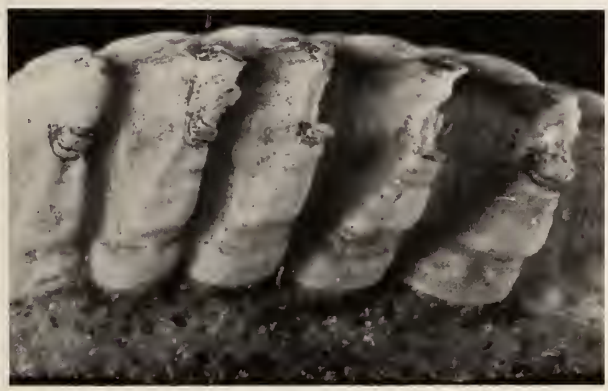

Figure 3

Figure 4

Figure 5

Figure 6

seum of Los Angeles County (LACM 1700). Color slides of the 2 largest paratypes, CASIZ Color Slides Series Nos. 1493, 1494, and 1495 (Allyn G. Smith's photographs).

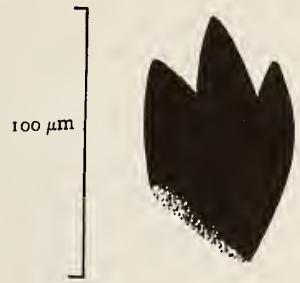

Figure 9

Lepidopleurus scrippsianus Ferreira, spec. nov. Holotype (CASIZ Type Collection no. 00716); head of major lateral tooth of radula. Camera lucida drawing by Barbara Weitbrecht. measured bar = 100μm

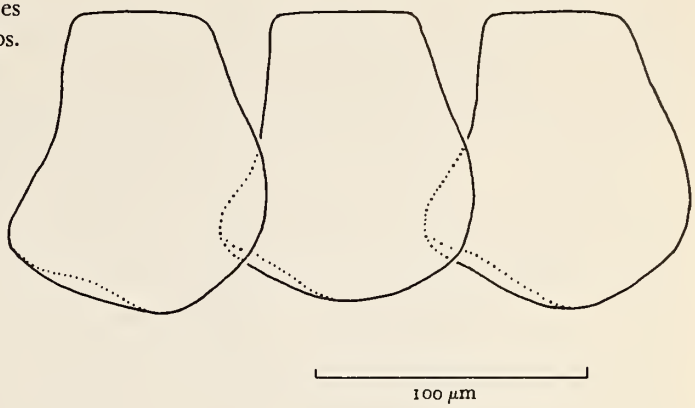

Figure 11

Lepidopleurus scrippsianus Ferreira, spec. nov. Holotype (CASIZ Type collection no. 00716); outer marginal teeth of radula. Camera lucida drawing by Barbara Weitbrecht measured bar = 100μm

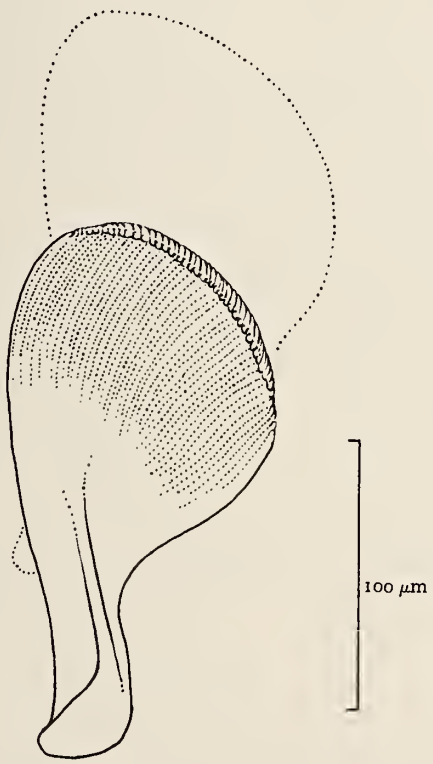

Figure 10

Lepidopleurus scrippsianus Ferreira, spec. nov. Holotype (CASIZ Type Collection no. 00716); spatulate tooth ("Seitenplatte") of radula. Camera lucida drawing by Barbara Weitbrecht measured bar = 100μm

Type Locality: – Off Baja California Sur, southwest of Cabo San Lucas, Mexico (22°30.8′N, 110°03.8′W through 22°37.2′N, 110°15.5′W), at a depth of 2891-2507 m.

Distribution: – *Lepidopleurus scrippsianus* is known only from the type lot.

Remarks: The genus *Lepidopleurus* Risso, 1826 (not Dall, 1879) is based upon *Chiton cajetanus* Poli, 1791, its type species by subsequent designation (Herrmannsen, 1847: 582). Although many lepidopleurids have been originally assigned to *Lepidopleurus, L. cajetanus,* with its rugose, thick, heavily sculptured shell is "strikingly different" (Pilsbry, 1892: 16) from other species of "*Lepidopleurus*" which, being "relatively delicate and smooth-shelled" (Berry, 1917: 233), are now allocated for the most part to *Leptochiton* Gray, 1847 (type species: *Chiton cinereus* Montagu, 1803 [= *C. asellus* Gmelin, 1791] (not *C. cinereus* Linnaeus, 1767) by subsequent designation, Gray, 1847). The recognition of fundamental differences between *Lepidopleurus* and *Leptochiton* has been variously handled by chiton workers (Dall, 1879; Pilsbry, 1892; Iredale, 1914a; Berry, 1917; A. G. Smith, 1960a; Van Belle, 1975); the systematic arrangement adopted here and elsewhere (Ferreira, 1979b), recognizes both, *Lepidopleurus* and *Leptochiton,* as distinct genera.

Lepidopleurus [*sensu stricto*] has been known only from its type species, *L. cajetanus,* a common European species distributed throughout the Mediterranean Sea, Canary

Islands, and the coast of Portugal and Spain, in the sublittoral zone to a depth of 40 m (Van Belle, 1978). The finding of *L. scrippsianus* in the eastern Pacific at a depth of over 2500 m adds appreciably to the understanding of the genus.

Lepidopleurus scrippsianus resembles *L. cajetanus* in several important respects, such as the 1) general shape, 2) rugose and thick shell, 3) beaked valves, 4) prominent lateral areas, 5) posterior mucro, 6) strongly convex postmucro, 7) posterior gills, 8) unslit articulamentum, 9) small, triangular sutural laminae, 10) very wide sinus, and 11) tricuspid major lateral teeth of radula. The 2 species differ sharply in the 1) end valves and lateral areas (with regular, concentric folds in *L. cajetanus;* with irregularly spaced, ill-formed growth rugae on an otherwise smooth surface in *L. scrippsianus*), 2) central areas (with longitudinal riblets in *L. cajetanus*; with no riblets but a microgranular surface in *L. scrippsianus*), 3) upper surface of girdle (with striated scales in *L. cajetanus;* with juxtaposed spicules in *L. scrippsianus*), 4) undersurface of girdle (with imbricating, flat scales in *L. cajetanus*; scaleless in *L. scrippsianus*), 5) radula's 6th tooth [Seitenplatte, or major uncinus] (fasciculated texture of the spatulate cusp in *L. scrippsianus*; no fasciculated texture observable in *L. cajetanus*), and 6) habitat (sublittoral in *L. cajetanus*; near abyssal in *L. scrippsianus*).

Lepidopleurus scrippsianus exhibits 2 anatomical features which, for their uniqueness and possible implications, deserve further comment: The fasciculated texture of the spatulate tooth of the radula, and the absence of scales on the undersurface of the girdle. The fasciculations or striae of the spatulate tooth are close together, neatly drawn in their course parallel to the long axis of the tooth; they continue to the curved outer edge of the tooth which assumes a comb-like appearance. In this manner, the spatulate tooth of *L. scrippsianus* is reminiscent of the monoplacophoran neopilinid's first marginal tooth (McLean, 1979), and the marginal teeth of some docoglossan limpets in the family Lepetidae. This observation seems to support McLean's (*op. cit.*) hypothesis of a close affinity among the Polyplacophora, Monoplacophora, and Docoglossa. In the case of *L. scrippsianus,* the radular similarities with neopilinids and certain limpets are reinforced by the relatively small size of the median (rachidian) tooth.

The absence of scales or any scale-like processes on the undersurface of the girdle of *Lepidopleurus scrippsianus* is also quite intriguing. All other Recent species of chitons known to me have scales on the underside of the girdle; probably such scales have a protective function, with adaptative value to these hard substrate dwellers. Thus, a scaleless undersurface such as found in *L. scrippsianus* suggests a soft substrate habitat that would pose no threat of imminent trauma to the moving girdle. Until now, a soft bottom habitat has not been known in chitons [although a few species are facultative dwellers on kelp stipes]; further investigation of deep water chiton species, still very poorly known, may well reveal other species, with a scaleless undersurface, associated with the soft bottoms of ooze of the abyssal sea floors.

In this respect, it seems significant to note that fossil chiton species are known to have lived on mud bottoms. *Pterochiton concinnus* (Richardson, 1965) described from the Mazon Creek area, Middle Pennsylvanian of Illinois, was quite clearly a soft bottom dweller (Yochelson & Richardson, 1979). Specimens of *P. concinnus* were found, as Dr. Eugene Richardson, Field Museum of Natural History, Chicago, graciously explains, enclosed in rock derived from a "silty mud. There are no rocks such as chitons might be expected to clamp onto. They had no choice but to wander on a mud surface which is what we mean by 'soft bottom.' Naturally . . . firm enough to support a vagrant chiton . . . The Francis Creek Shale [of the Mazon Creek area] . . . was deposited in small increments that immediately consolidated to a sufficiently firm state to support the vagrant benthos. We have one instance of a curled chiton lying 3 centimeters below a straight one. As I interpret it, the lower one was killed (perhaps by fresh water preceding the mud) and then buried by 3 cm of mud, and then the other fellow wandered along and was buried alive." (Dr. E. Richardson, *in litt.,* 28 August 1979). But the argument for soft bottom living in the case of *Lepidopleurus scrippsianus* is not totally unequivocal, for there were some hard surfaces available in the collecting area. Field notes for the station MV 65-I-57 (kindly supplied by Spencer R. Luke, Scripps Institution of Oceanography), where *L. scrippsianus* was found indicate a soft, muddy bottom; but it also shows that there were some rocky, "asphaltic" pieces in the area, and that the chitons (1 specimen of *Leptochiton alveolus,* and the 4 specimens of *Lepidopleurus scrippsianus*) together with limpets and several specimens of a *Neopilina* sp., were picked off a "very hard and heavy" piece of wood. Still, taking into account two relevant anatomical features of *L. scrippsianus,* the unusually wide girdle (providing for a broader contact surface and better distribution of weight) and the scaleless undersurface (inadequately prepared to meet the harshness of hard substrata), it seems that the bulk of the evidence speaks for an association between this nearly abyssal species and a soft bottom.

Lepidopleurus scrippsianus inhabits exceptionally deep water as may be appreciated from a compilation of deep-water chiton species and their respective bathymetric

Table 1

Compilation of deep-water chiton species with respective bathymetric ranges.

Species	Depth (m)		Cited in
	Minimum	Maximum	
Lepidopleurus vitjazi Sirenko, 1977		7657 - 6920	Sirenko, 1977
Leptochiton alveolus (Lovén, 1846)	164	4825	Ferreira, 1979b; Kaas, 1979
Leptochiton incongruus (Dall, 1908)	589	3612 - 3541	Dall, 1908; Ferreira, 1979b
Lepidopleurus scrippsianus Ferreira, n. sp.		2891 - 2507	Ferreira, herein 1980
Leptochiton pergranatus (Dall, 1889)	208	2161	Kaas, 1972
Lepidopleurus planus Nierstrass, 1905		2053	Nierstrass, 1905
Lepidopleurus rissoi Nierstrass, 1905	216	2053	Nierstrass, 1905
Ischnochiton abyssicola A. G. Smith & Cowan, 1966	216	2000	A. G. Smith & Cowan, 1966
Leptochiton assimilis Thiele, 1909 [? = *L. rugatus*]	8	2000	Jakovleva, 1952
Placiphorella atlantica (Verrill & E. A. Smith, 1882)	640	1470 - 1420	Thiele, 1909; Kaas, 1979
Lepidozona retiporosa (Carpenter, 1864)	0	1463 - 1262	Ferreira, 1978
Lepidozona scabricostata (Carpenter, 1864)	0	1460 - 1260	Ferreira, 1978
Lepidopleurus lineatus Nierstrass, 1905	450	1301	Nierstrass, 1905
Lepidopleurus setiger Nierstrass, 1905	289	1301	Nierstrass, 1905
Lepidopleurus similis E. A. Smith, 1894		1235	E. A. Smith, 1894
Leptochiton leloupi Kaas, 1979	800	1085	Kaas, 1979
Leptochiton tenuis Kaas, 1979	800	1080	Kaas, 1979
Connexochiton platynomenus Kaas, 1979	800	1050	Kaas, 1979
Ischnochiton exaratus (Sars, 1878)	100	1000 - 880	Leloup, 1956; Kaas, 1979
Ischnochiton dorsuosus (Haddon, 1886) [? = *I. exaratus*]	199	1000	Dell, 1964; Righi, 1971
Leptochiton cancellatus (Sowerby, 1839)	0	920	Kaas, 1979
Leptochiton binghami (Boone, 1928)	659	885	Ferreira, in *ms.*; Boone, 1928
Ischnochiton albus (Linnaeus, 1767)	0	815	Jakovleva, 1952; Kaas, 1979
Ischnochiton dallii (Haddon, 1886)		732	Haddon, 1886
Oldroydia percrassa (Dall, 1894)	0	731 - 640	Ferreira, 1979b
Callochiton gaussi Thiele, 1908	5 - 0	730	Dell, 1964; Hedley, 1916
Ischnochiton stearnsi Dall, 1902	412	715	A. G. Smith & Cowan, 1966
Nuttalochiton mirandus (Thiele, 1906)	126	640	Arnaud, 1974
Cryptochiton stelleri (Middendorff, 1847)	0	600	Jakovleva, 1952
Hanleya hanleyi (Bean 1844)	15	555	Jakovleva, 1952
Placiphorella borealis Pilsbry, 1892	0	500	Jakovleva, 1952
Placiphorella uschakovi Jakovleva, 1952	0	500	Jakovleva, 1952
Leptochiton diomedeae Berry, 1917		463 - 446	Berry, 1917
Leptochiton rugatus (Pilsbry, 1892)	0	458	Ferreira, 1979b
Hanleyella oldroydi (Dall, 1919)	18	455 - 420	Ferreira, 1979b
Ischnochiton nipponicus Berry, 1918		357	Is. Taki, 1962
Leptochiton kerguelensis Haddon, 1886	0	342	Arnaud, 1974
Callistochiton colimensis (A. G. Smith, 1961)	0	340 - 330	Ferreira, 1979a
Leptochiton asellus (Gmelin, 1791)	40	300	Jakovleva, 1952
Tonicella rubra (Linnaeus, 1767)	0	300	Jakovleva, 1952
Lepidozona willetti (Berry, 1917)	40 - 13	274	Ferreira, 1978
Gurjanovillia kobjakovae Jakovleva, 1952	50	270	Jakovleva, 1952
Hanleya tropicalis Dall, 1881		234	Dall, 1881
Tonicella marmorea (Fabricius, 1780)	0	230	Sirenko, 1974
Lepidozona sinudentata (Carpenter *in* Pilsbry, 1892)	0	200	Ferreira, 1978